THE NATIONAL PHYSICAL LABORATORY DURING 1907.

THE report for 1907 of the National Physical Laboratory, presented to he general board on the occasion of the annual meeting and inspection of the laboratory on March 20, contains abundant evidence of the rapid growth and extension of its activities during the past few years, as well as of the usefulness and importance of the research work which such an institution is able to undertake. Following closely upon the report of the Treasury Committee, which has done valuable service, both to the laboratory and to the public, in defining more precisely the limits to be set and the conditions to be observed in regard to the acceptance of certain classes of test work, this account of the past year's work affords conclusive evidence that the organisation of special departments for the verification of instruments and examination of materials need be no hindrance to the concurrent prosecution of those researches which constitute the most important part of the laboratory's work.

It is interesting to note the changes effected since the opening of the laboratory in 1901. Apart from the observatory department at Richmond, the laboratory originally comprised a physics department at Bushy House and an engineering department housed in an adjoining building of two bays. At the present time the accommodation afforded in Bushy House is supplemented by that of three other buildings, together covering an area at least double that of Bushy House itself, in addition to a smaller building mainly devoted to the test work for the Indian Government, transferred to the laboratory from Coopers Hill, and a special building erected for the War Office standard leading screw lathe. Of the three larger buildings, the engineering building is now nearly doubled in size; the building for electrotechnics and photometry was completed in 1905, and considerable progress has been made with its equipment, which is described in a special appendix to the report, referred to below; while the building for metrology has been more recently erected, and the transference to it of the comparators and apparatus for measurements of length is only now being begun. One special feature of the metrology building is a long passage arranged for the verification of 50-metre surveying tapes and wires, whether on the flat or in catenary.

Fig. 1.—General view of large bay of Electrotechnical Building, looking east.

Of general public as well as of special scientific interest is the completion of the new magnetic observatory at Eskdalemuir, in Dumfriesshire. Primarily intended for the resumption of the magnetic work interrupted at Kew by the coming of the electric tram, it will be equipped generally with the recording and other apparatus necessary to a first-class meteorological station, and will maintain a close connection with its parent institution at Richmond. Dr. Chree's admirable work in the analysis and interpretation of the Kew records will thus be continued and extended. Eskdalemuir is situated towards the head of the Esk valley, some eighteen miles from Lockerbie on the Caledonian, and from Langholm on the North British Railway, sufficiently far from the nearest point of either line to be secure from magnetic disturbance. The locality promises to be no less free from social perturbations, and the relief measures to be adopted in the event of a severe winter will no doubt engage the attention of the committee at an early date. Mr. G. W. Walker, of Trinity College, Cambridge, and Glasgow University, is the first superintendent.

Among other matters of general interest, one or two branches of work recently undertaken by the laboratory may be referred to shortly. The transference to the laboratory of the Indian Government test work has led to the formation of a new department, of which Mr. Rosenhain is superintendent. The equipment of the new building in which the work is carried out has been systematically planned with the view of securing ease and rapidity of working; a description of the arrangements and of the methods of analysis employed is given in the report of the department.

The testing of taximeters, undertaken for the Commissioner of Police, has aroused a good deal of public attention. The tests applied consist of an exhaustive examination both in the laboratory and on the road of one instrument of a type, and of its mechanism, and of a simpler verification of the accuracy of each individual instrument. The tests are carried out at the laboratory, but a building has been erected in the Lambeth Road for the reception of taximeters for re-examination after use.

The testing of glow-lamps under the specification issued by the Engineering Standards Committee may also be mentioned here. The Lamp-testing Bureau of New York is responsible for reporting annually on some 13,000,000 lamps, to the benefit alike of the manufacturer and the consumer. Indications are not wanting of a demand for such tests in this country; increased facilities for the work are being provided in the photometry department.

Turning now to research, the papers published during the year include some of the most important work carried out by the laboratory. Foremost among these must be mentioned the three papers on the fundamental electrical

units, for which—in conjunction, as regards some parts of the work, with Prof. Ayrton, Mr. Mather, and Dr. Lowry—Mr. F. E. Smith is responsible, and which, with an earlier paper on mercury resistance standards, embody the results of the work of the electrical standards department from the foundation of the laboratory. We shall, no doubt, have occasion to refer more particularly to these three papers in dealing with the "Collected Researches" of the laboratory, vols. iii. and iv. of which are now ready for issue. The ampere balance, planned originally by Viriamu Jones and Ayrton, the electrical part of which was constructed at the laboratory, with such modifications of the original design as experience showed to be necessary, under Mr. Smith's supervision, has given results "far exceeding that secured in any absolute determination of any electrical unit. . . . The balance was intended to give the ampere to 1 part in 10,000, but about 1 part in 50,000 appears to have been attained. A little uncertainty exists as to the value of g and the axial length of the coils; the latter uncertainty may shortly be removed" (by the construction of new coils).

The work on the comparison of various forms of silver voltameter has led to results of the same order of accuracy. Mr. Smith has shown that under specified conditions all the different types of voltameter experimented with give identical results for the electrochemical equivalent to within 2 parts in 100,000. In a suggested specification for the international ampere the Rayleigh form is recommended as the easiest to erect.

The paper on the Weston cadmium cell summarises the results of all the observations made at the National Physical Laboratory, and establishes the reproducibility and constancy of the cell. The results of comparisons between American, French, German, and English cells are given in the report, and show that standard cadmium cells can be set up by different experimenters with different materials to agree within a few parts in 100,000.

The results obtained in these researches and in those simultaneously carried on in the standardising institutions at Washington, Paris, and Berlin should make the way clear for the International Conference on Electrical Units to be held in London probably this year. Mr. Smith is to be congratulated on having placed the laboratory in the forefront of the institutions engaged in this work. The construction of the Lorentz apparatus, to be presented to the laboratory by the Drapers' Company, has been already commenced, and may perhaps be completed within the current year.

The research work of other departments must be dealt with more shortly. Mr. Campbell has published a valuable series of papers on mutual inductances: construction of standards, and methods of measurement. These latter include the use of a novel form of vibration galvanometer. Dr. Harker's high-temperature work has been delayed by his illness, but a new type of high-temperature furnace has been devised which promises well for the uniform heating of fairly large objects to about 2500° C. In the metrology department much time has been devoted to the development of methods of measurement of screws, and a 4-metre standard bar has been divided and calibrated. Mr. Hunter, in the optical department, has devised a method of considerable interest for the measurement of definition, more especially of photographic lenses. In the electrotechnics department a research on the dielectric resistance of insulating materials, undertaken for the Engineering Standards Committee, has been delayed by the failure of the 100,000-volt transformer under construction.

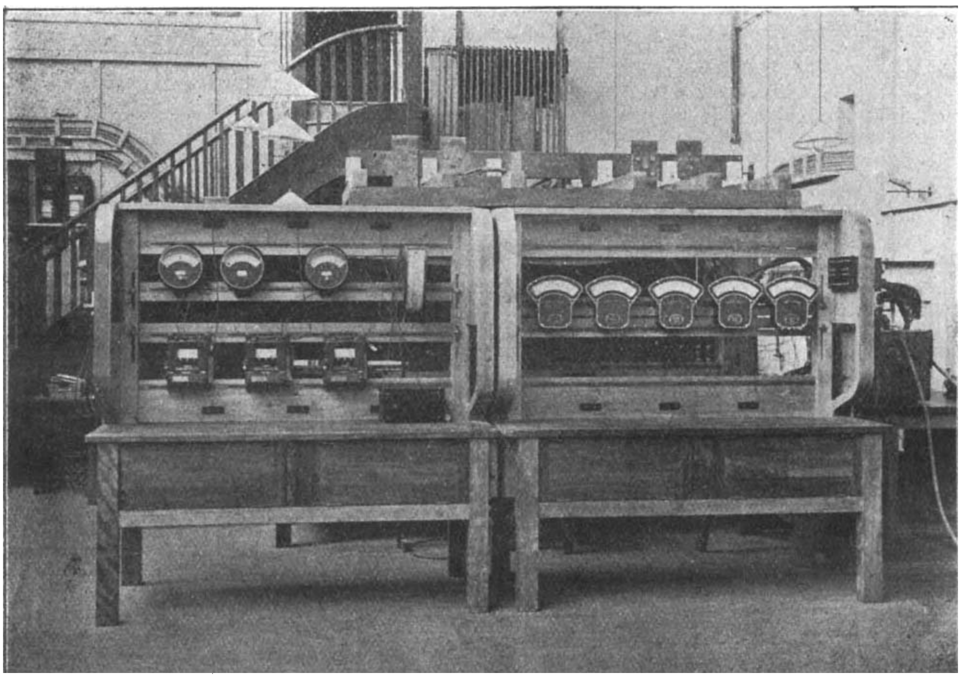

FIG. 2.—General view of one of the instrument-testing stations.

In the engineering department, Dr. Stanton has completed some important researches. The wind-pressure work has established interesting results as regards the relative pressures on large and small plates, which receive remarkable confirmation from the experiments of M. Eiffel. The comparison of open-air results on large models with those obtained earlier for small models shows that the values for large surfaces in the open can be inferred with accuracy from observations in the laboratory. Other researches carried out deal with the resistance of materials under repeated stresses and blows in four forms of impact testing machine, and the elastic limits of material under alternating stress.

In the new department for metallurgy Mr. Rosenhain has been very active, and at least three researches of first-rate importance were in progress during the year under his direction. The most interesting is perhaps the investigation of the alloys of aluminium, copper, and manganese, in continuation of the work carried out by Dr. Carpenter on the aluminium-copper alloys, which appears in vol. iii. of the "Collected Researches." For the purpose of the metallurgical research an ultra-violet microscopic outfit has been installed for obtaining photomicrographs at magnifications up to 3600 diameters.

The report is followed by an appendix, which gives some details as to the equipment of the electrotechnical laboratory (including the department for photometry). Much yet remains to be done to complete the equipment of this building, but the arrangements have been planned with the view of meeting the demands which are likely to arise, and the account given is of no little interest and

utility. The chief feature is probably the careful provision made for the distribution of voltage and current about the building, the utmost flexibility in this respect being essential for the varied purposes of test and research.

The building—mainly on one floor—comprises one large bay (Fig. 1) for machines and alternating current test work, two parallel rooms of half the area for heavier test work and resistance and direct-current work respectively, with offices and workshops beyond. The photometry section, on two floors, runs at right angles to these on the east. Above are the rooms for the photometric measurements, with a 90-feet track for arc-lamp work; the ground floor provides accommodation for life tests, and is already largely occupied with the specially designed life-test racks necessary to cope with the probable demand to which reference has been already made. The results of the work on light standards at the laboratory since 1903 were laid before the Institution of Electrical Engineers by Mr. Paterson in December, 1906, in a paper which gained an institution premium, and much time has been devoted during 1907 to work on the pentane standard, while the photometry of differently coloured lights is also receiving attention.

The instruments for alternating current standard work occupy the centre of the main bay (Fig. 1); on the right, under a platform to screen off light, are the two standard electrostatic voltmeters, reading up to 400 volts, on two approximately circular scales 26 feet in length, with an accuracy of 1 part in 10,000. Outside the building, on the opposite side of the main bay, is a small, entirely detached, fire-proof high-tension transformer house, to be occupied by the 100,000-volt transformer, with the aid of which it is proposed that Mr. Rayner should continue the valuable researches on insulating materials already published. Twelve-inch ducts carry the high-tension current into the large bay.

Fig. 2 gives a general view of an instrument testing station—or testing bench—at the east end of the large bay (see Fig. 1). The bench part of the stand in front is arranged as a cupboard with glass top, in which instruments of horizontal type can be tested at any temperature; for other purposes the glass can be covered with teak lids. The back compartment contains heating lamps and a fan for carrying the heated air to any part of the station, the upper part being arranged so that it can be covered with a thin celluloid cover. Above the station may be seen the main heavy current leads. In Fig. 3 are shown the water-cooled regulating resistances employed for heavy current work of 6000 amperes capacity.

The resistance room, in charge of Mr. Melsom, contains arrangements for all high and low resistance work, except that on ultimate standards; for tests on cables, insulation testing sets, &c., and for dry-cell testing. For accommodating accumulators under test a small building has been erected outside the north wall.

Mr. Paterson and his collaborators have given the utmost attention to all detail throughout the building, the benefit of which will doubtless be felt as the work increases.

Although the development of the laboratory since 1901 has been rapid, it is clear that even now it has but barely reached its most active period of growth. The need and the value of the services it can render become progressively more apparent, and Dr. Glazebrook's able administration and untiring energy may be expected to produce even greater, if perhaps not so obvious, advances in the next seven years.

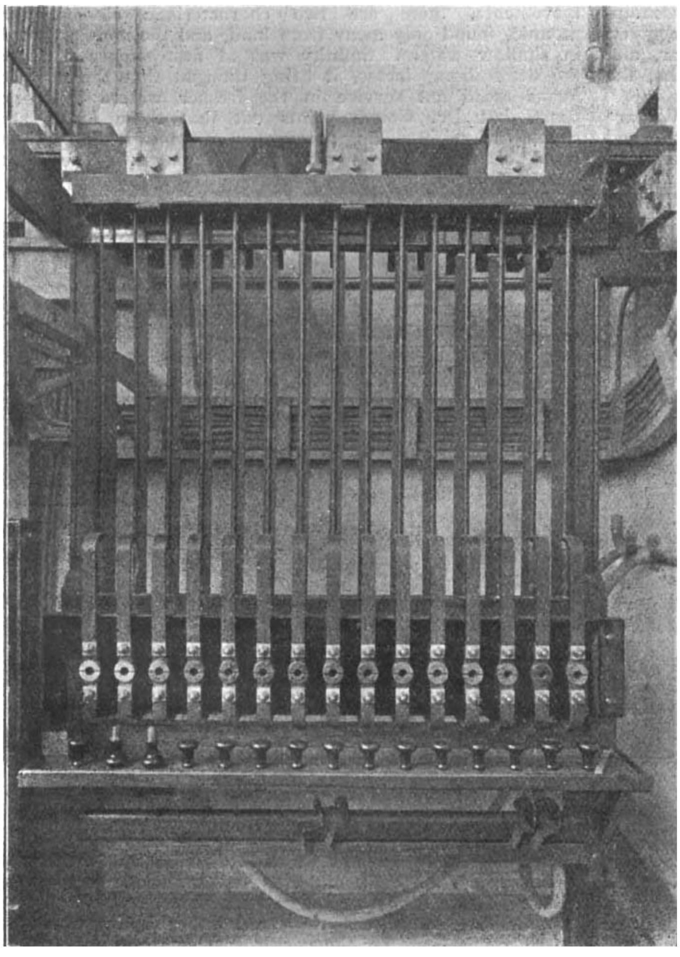

FIG. 3.—Water cooled regulating resistances—capacity 6000 amperes.

THE NORTH SEA FISHERIES INVESTIGATIONS.

WHEN the British Government in 1902 undertook to cooperate with other countries bordering on the North Sea in an investigation into the fisheries of that region, it delegated its share of the work in the north to the Scottish Fishery Board and in the south to the Marine Biological Association of the United Kingdom. The latter has now issued its second report upon the work done by its naturalists and hydrographer covering the period 1904–5.

Four papers are included, and the first is by Dr. Wallace on the age and growth-rate of plaice in the southern North Sea, and is the result of the application of a method of determining the age of the fish by the otolith or "ear-stone." Various attempts have been made to determine the age of fishes. The scales furnish some evidence, but in most cases, at any rate, they are hard to read. The otolith method, on the other hand, is easy, and much more rapid than the scale method.

The otolith shows on its surface a series of concentric rings alternately light and dark, and Reibisch in 1899 found that each light ring represented the growth of the otolith during the summer, while the dark rings represented winter growth. There seems to be no difference in structure in the alternate rings, the different appearance being produced entirely by a difference in the density of the substance. In the light opaque rings the particles are more closely packed, while in the dark more or less transparent rings the particles are farther apart. Since